

# The Initial Conceptions for Earthquakes Phenomenon for Moroccan Students of the First Year Secondary College

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## Abstract

This work proposes initially to identify the initial conceptions of Moroccan students in the first year of secondary college about the notion of earthquakes. The used methodology is based on a questionnaire addressed to students of life science and Earth in Meknes city, before any official teaching about the said phenomenon. The obtained results showed that despite the non-responses, the majority of respondents have less accurate initial conceptions for earthquakes notion, and does not correctly write their answers, they are enough to write snippets of sentences and do not use scientific words. The student's conceptions seem marked by the earthquakes effects. However, we have identified correlations between the initial conceptions of Moroccan students and those of other French, Turks and Tunisians students.

**Keywords:** Initial designs, Concepts earthquakes, college Secondary cycle, Correlation.

## 1. Introduction

In recent decades research on students' conceptions about biological, geological or other, phenomena has grown steadily (Rumelhard 1986; Astofi & Peterfalvi 1993; Peterfalvi 1997a & 1997b). Indeed, researchers and teachers of different subjects agreed on the fact that traditional teaching methods do not yield the expected results in the knowledge acquisition and skills since students do not adhere the construction of their knowledge. Thus, it is seemed important for a teacher to take into account the knowledge and belief of the knowledge of students before any learning; identify their conceptions and obstacles nature to the new knowledge acquisition (Astophi 1992 ; Astophi et al. 1998; Giordan de Veech 1989 ; Giordan et al. 1994; Girodan De Vecchi 1987; Boucherie et al. 1994; Astophi et Develay 1989; Orlandi 1991, Sauvageot 1991, Clément 1991; El Hrairi 2004; Chalak 2012). Indeed, as a tool, the initial conceptions of the students provide a starting point and also a way to imagine the adequate learning sequences.

However, the studies of the conceptions concerning various geological concepts have been the subject of much research in science education (Triquet 1988; Allain 1995; Laperrière-Tacussel 1995; Orange 1995; Goix 1995; Gouanelle & Schneeberger 1995; Mouhsim 1997; Crépin-Obert 2010; Chalak & El Hage 2011; Chalak 2012). They showed that the majority of students presented many ideas on the earthquakes notion and therefore they have only a superficial knowledge about this geological phenomenon. Thus, Allain (1995) highlighted several designs of 3 cycle students on the causes of the earthquakes phenomenon. He classified them into seven categories based on the content of the productions of these students: volcanic causes, internal to the natural terrestrial globes, atmospheric, tectonic, human, and alien and causes in association with the earth rotation. In this study, we were interested in achieving the objectives listed below.

## 2. Goals and objectives

In Morocco, to our knowledge; no research has yet focused on secondary college students' conceptions about the earthquake notion. For this purpose, we asked the following question: what are the initial conceptions about the earthquakes notion for first year secondary college students above all education and plates tectonic study in Life Sciences and Earth?

Recall that we wanted to work with students in the first year of secondary college who studied in principle earthquakes and plate tectonics at this level, but at the time of questionnaire distribution the students had already studied this phenomenon.

Thus, we chose the students of the first year of secondary college which do neither studying plate tectonics in general, nor the earthquakes phenomenon in particular at this level, to achieve the following objectives:

- Identify the initial conceptions for students about the earthquakes phenomenon;
- Discuss the origins of these conceptions;

- Put the obtained results available to the program makers, teacher trainers, inspectors and teachers in order to have more informations about the field in which they work and take more account of the initial student's conceptions in their practices to improve learning for students
- Be able to later offer these conceptions from a training sequence so that future teachers may be appropriate and be more susceptible for errors of students who they can to provide security;
- Be able to later compare the conceptions and prerequisites and measure the understanding level of student for different grade levels and detect some problems that students receive upon learning of earthquakes.

### **3. Methodology: Population and data collection instrument**

We conducted a survey during the school year 2013/2014. We chose 188 students in the first year of secondary college, their ages range between 12 and 14 years. These students are spread over five classes in five public colleges (denoted C1, C2, C3, C4 and C5) located in the provincial delegations of Education of Meknes in Morocco (Table 1). The choice of these institutions is related to reasons of facilitating the research process. For the collection of data related to the problem under study, we used the questionnaire as an investigative tool. The time that was given to reply to the various questions is 20 minutes. The questionnaire was administered to students before teaching the earthquake concept, since our research is an essay on the initial conceptions of the non steep acquired knowledge. This questionnaire contains two parts. The first part refers to the scientific content, it includes three questions. The first contains two items relate to the meaning of the earthquake through writing and drawing. The purpose of this is to have an idea of how the interviewed students represent the quake. The second question gives information on the explanation that can present the students to explain the earthquakes origin. The third question contains three items; item 1 and 2 relate to the conception of students in respect of seismicity in Morocco. Item 3 as Question 2 provides information on the explanation that can present the students to explain the earthquakes origin in Morocco. The second part of questionnaire comprises a single question with two items concern the awareness side and preparing students to hold behaviors (during and after) in the event of an earthquake. These questions are grouped in Table 2.

### **4. Results and Discussion**

The four questions above will allow us to follow the discussion of the respondents, and see how they conceive the earthquake notion.

#### *4.1. Scientific Concept of earthquake*

##### *a- Question 1*

The question 1 has the sense to give the earthquake definition with a text (item 1) and draw a diagram to explain how this phenomenon arises (item 2). Figure 1 shows the obtained results for item 1 (what is an earthquake for you?). It is noted that 19 % students did not respond to this item which 3 % responded "I do not know". While all the other students tried to answer to this item. We noticed the similarities and differences in the definitions. Thus, the percentages response are distributed as follows: 29 % of students defined the earthquake phenomenon by its destructive effect "human and material damage causes", only 4 % regarded it as a natural phenomenon, 13 % repeated simply the quote "tremble of earth", 11 % and 4 % respectively confused the earthquake with the volcano and thunder, other students (16 %) defined it as "a very strong wind." We can conclude that the initial designs of the students about the earthquake definition are multiple, varied and unscientific. Indeed, the majority of respondents are very far from having clear ideas about the earthquake concept since rely on atmospheric phenomena (wind, thunder), natural phenomena (volcanic) or to define the destructive events an earthquake. This conception typology, is inspired by the work of Allain (Allain, 1995).

For more information to the scientific concept, it was asked students to diagram how the earthquake occurs using item 1 (explain using a drawing how an earthquake was occurred?). The obtained results are presented in Table 3. Following to the obtained patterns with this item (Figure 2) ignoring the non-response (21 %) it is noted that students are more descriptive to explanatory productions. Indeed, the majority of students (66 %) are more interested to the catastrophic effects of the phenomenon rather than its scientific explanation: destroyed houses (36 %), houses or mountains with breaks with a percentage of 11 % and 19%, respectively. In addition, some diagrams about (13%) (Figure 2) showed conceptions using huge sea waves (probably refers to these students Tsunami, we recall that the tsunami is not taught in the official program) and strong wind. These results correlate to those reported by Allain and Boughanmi (Allain, 1995; Boughanmi, 2013).

In the others hand, these results identify that the students of this level are struggling to define an earthquake or to design its operation. These results correlate with those reported by other researches ( Orange, 1995; Deltail et al., 2003, Boughanmi & Orange, 2005). Indeed, the majority of respondents are very far to have a clear ideas about earthquake phenomenon because they have confused to volcano or atmospheric phenomena and they are attached to the destructive earthquakes and omitting relations with the fault (case of tectonic earthquake). They also have a significant lack of scientific vocabulary. These results can be explained either by the absence of the

earthquake-term in the vocabulary of non-response to question 1, or a lack of their motivation. The same results were obtained by Dal (Dal, 2005). In addition, we can explain these results by the fact that: the students have not enjoyed this questionnaire because they knew that it is not an exam, they do not enough time to write their answers or They have an unofficial acquisition of certain concepts that will be developed by studying earthquakes at the classroom. Indeed, the absence of such notions can block these students as it was reported by Goix (Goix, 1995) and push them to use fragments of knowledge or partially erroneous extra-college origin.

*b. Question 2*

This question aims to explain the earthquake causes (Explain why the earth shakes?). The obtained results are presented in Table. It is seen that the percentage non-response is roughly the same as the previous question (item 1) (16 %). However, the majority of students have tried to explain the earthquake causes. From their production and according to the explanations they reveal the earthquake causes, we have developed four types. Three have correct answers and involve human causes (21 %), tectonic causes (13 %) and volcanic causes (11 %). Moreover, we noted that other students receded and involved atmospheric causes: the very strong wind (16 %), floods (15 %) and thunder (8 %). These results identify the difficulties of students to understand the earthquake causes. Especially the explanations of respondents reported a significant lack of scientific knowledge; which would push them to use their common knowledge, even for those who have responded positively to this question. These can be explained by the non-acquisition and vocabularies notions adequate to explain their ideas, which will be developed by studying earthquakes in the classroom. These results correlate with those of many students in cycle 3 that evoked the same causes to explain the earthquake causes (Allain, 1995).

*c. Question 3*

This question has three items; item 1 (Will it have earthquakes in Morocco?) and item 2 (Give examples of cities that have experienced earthquakes in Morocco?) concern the conceptions of students in respect of seismicity in Morocco. The item 3 (Do earthquakes occur in Morocco?) provides information on the explanation that can present the students to explain the origin of earthquakes in Morocco. Figure 3 showed the obtained results about item 1. It is noted that the percentage of the correct answers is particularly high (above 90 %). Against the percentages by non-responses or false responses remains reduced, they are about 6 % and 2 %, respectively. These results suggest that respondents largely to know that Morocco experienced earthquakes.

Moreover, to obtain further information in item 2, he was asked the students about the name of some Moroccan cities that experienced an earthquake. The obtained results are summarized in Figure 4. It is remarked that the surveyed students (91%) know the names of some Moroccan cities which experienced the earthquake, referring to Agadir and / or Al Hocéma cities. While only 9 % of students who have not answered this question.

The results mentioned above can probably be explained by an extra-school provision among other things, the extensive media and the ability to access it (the TV show: documentaries, websites ...) (Boughanmi, 2013; Alava, 2011) and the family language ... ect.

On the other hand, to take more information about the earthquakes causes, another question has been proposed (Do earthquakes occur in Morocco?). Table 5 showed the student categories explanations about the earthquakes origin in Morocco. Indeed, based on the content of the written work of students, we have defined four categories of explanation: 16 % of students have explained the earthquakes origin in Morocco by floods (atmospheric causes); 11 % considered the presence of the mountains (geological structures) as the origin of earthquakes. Furthermore, 8 % of the students affirmed that the earthquakes origin is related to the geographical location between two seas (location) and 4 % have attributed to the population explosion (human cause). From these results, we can see that the majority of respondents (61 %) did not respond to this item.

We conclude for this item that students have been unable to justify why Morocco can know occasionally earthquakes phenomena. This is in part indicative of insufficient knowledge of the earthquakes causes as noted above, or this issue is beyond their knowledge. Indeed, such notions will be acquired as and when they would study plate tectonics to be able to probably think on a global scale.

*4.2. Awareness side and preparing students for hold behaviors (during and after) in the earthquake event*

For this last question (Question 4) of the questionnaire, we selected two items which students make explicit through the individual written their initial spontaneous ideas regarding: Mastery or at least awareness through instructions to follow during and after an earthquake. Indeed, Item 1 awareness side has been proposed (What to do when the earthquake struck in the classroom and at home?). The obtained results are illustrated in Figure 5. It is noted a quasi-equality of non-response percentages (37 %) and those who answered "do not know" 36 %. Also, 27 % of students have the correct answers.

However, another item beside awareness and preparing students for held behaviors after the earthquake event (item 2: what to do after the earthquake). The obtained results are shown in Figure 6. It is seen that these results

confirm what has been said above about the item 1. So, 16 % of students responded positively to this item and the majority do not know what to do or did not respond with percentages of 46 % and 38 %, respectively.

These results show that overall the respondents are very far from being aware of good practices (safety instructions) to follow during and after the earthquake event. These low percentages (still below 40 %) are not surprising, since textbooks are not focused on raising awareness of earthquake risks and no education for students in classes or even teachers in the prevention of these phenomena are not conducted.

## 5. Conclusions and Prospects

It appears from this study that the Moroccan students of the first year secondary college have the initials conceptions about the earthquake notion before education at school. Such conceptions are limited largely to the visible characters by eye which they are focused on the destructive effect of earthquakes (human and material damage) omitting their origin both in Morocco and in general. Thus, the relatively simple and non-scientific ideas used by students to reason and the difficulties in seizing the destructive nature of the phenomenon may reflect external contributions to school; among other familiar language, extensive media (TV show: movies, cartoons or other) (Boughanmi, 2009; Dal, 2005; Alava, 2011) or the family register ... ect.

It seems that students, even if they mobilize certain just causes, remain focused on the dramatic effect of the earthquake, as these students have no concept of plate tectonics. In addition, the spectacular catastrophic picture presented by the media could impede the apprehension of a scientific explanation of this tectonic event.

These results correlate with those reported by other researchers who have worked on the conceptions of the students about earthquakes ( Allain, 1995; Dal, 2005; Boughanmi, 2009; Heringuez, 2012). Thus, the level difference of education or learners of the countries do not result in a significant difference in conceptions. For this, we can propose a supportive action to future teachers of Life Sciences and Earth at the Regional Centers for Education and Training and to exercisers teachers in schools and program makers. It covered:

- i- Initial and continuing training of teachers to introduce them to consider the initial conceptions of students about the studied phenomena before any formal education, in order to adapt their interventions and regulate their practices in an educational strategy to develop them.
- ii- Make students aware of their own representations must also be a start, and compare their conceptions to make lasting change must be a constant objective for the teacher.
- iii- The integration of safety precautions to follow when and after the earthquake in various textbooks without exception and promote activities and simulation exercises.
- iv- On the training plan, should be emphasize the need to develop or generalize academic training for teachers to deal with the earthquakes phenomena and other natural disasters.
- v- Adopt at an early stage in primary school, a playful character education of geological phenomena such as earthquakes.

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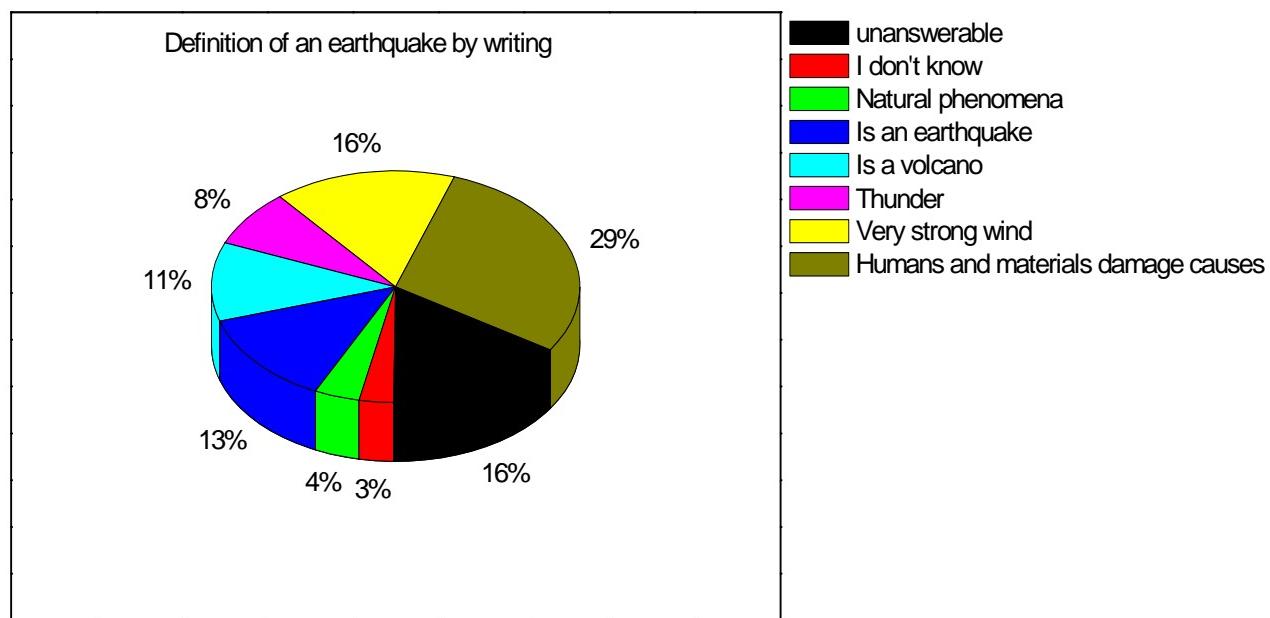


Figure 1. Relative conception of the definition earthquake by writing.

| Explanation: Citations examples | Examples of drawings |  |  |
|---------------------------------|----------------------|--|--|
| Homes with breaks               |                      |  |  |
| Sea waves and wind              |                      |  |  |
| Mountains with breaks           |                      |  |  |

Figure 2. Examples of drawings of student

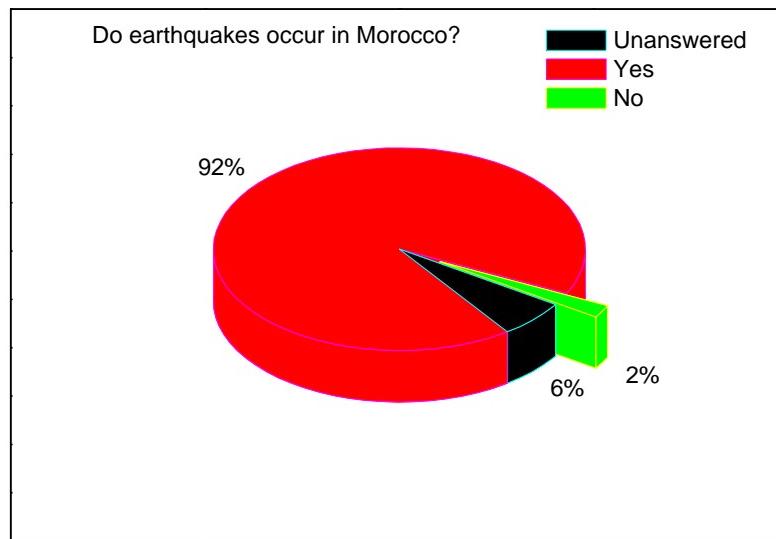


Figure 3. Conceptions relating to the production of earthquakes in Morocco

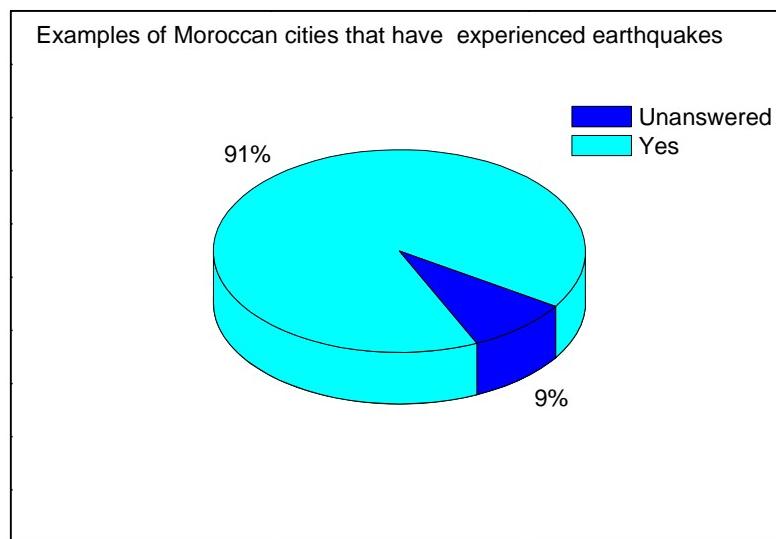


Figure 4. Conceptions relating to the name of some Moroccan cities that experienced an earthquake

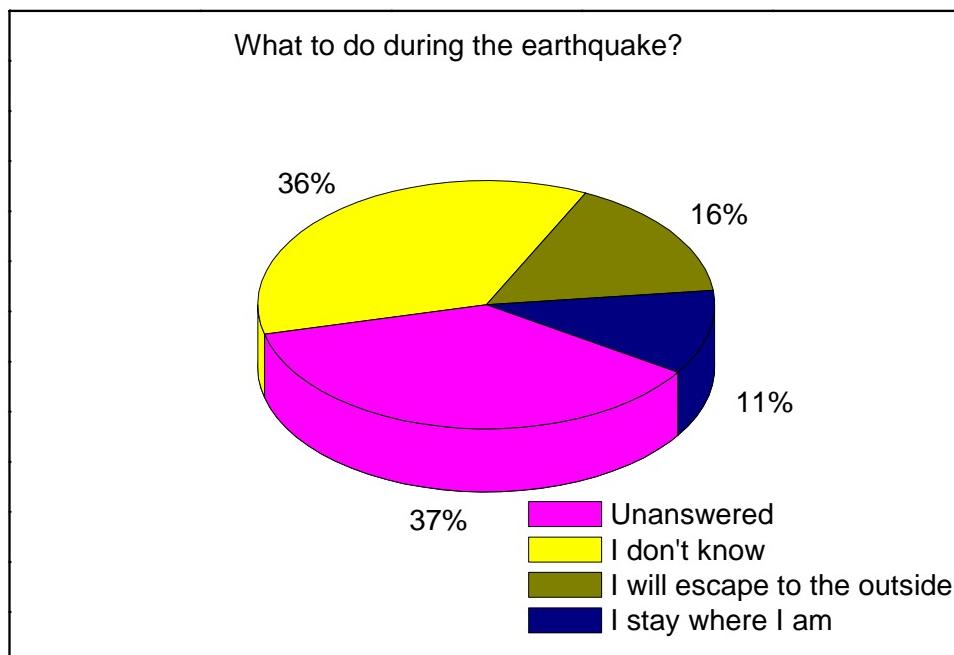


Figure 5. Conceptions relating to the set requirements at the moment of earthquake.

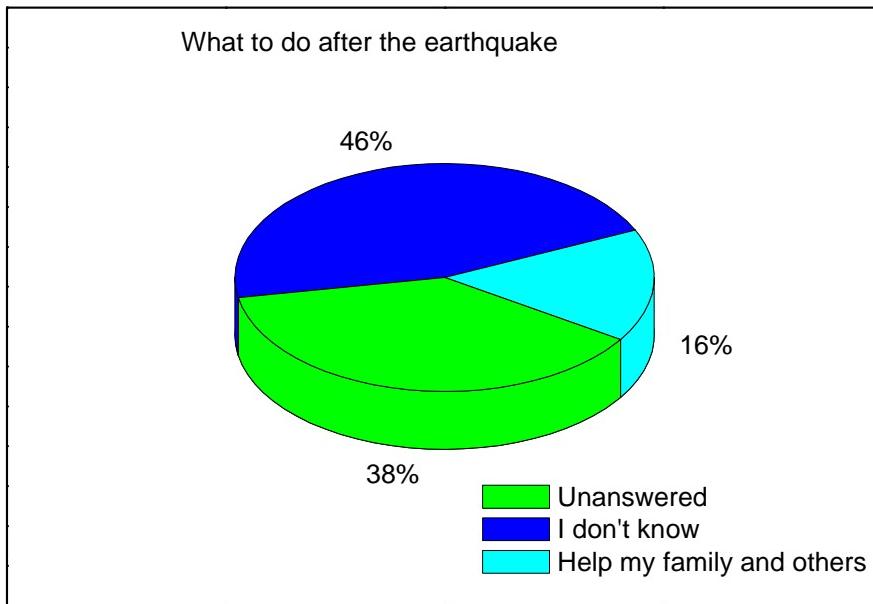


Figure 6. Conceptions of good practice to follow after earthquake

Table 1. Establishment and number of students in the studied research sample

| denoted of colleges establishment | C1 | C2 | C3 | C4 | C5 |
|-----------------------------------|----|----|----|----|----|
| Students number per class         | 38 | 36 | 39 | 38 | 37 |

Table 2. Principals items of the proposed questionnaires for the studied population.

| Questions  | Items                         | Questions                                                             |
|------------|-------------------------------|-----------------------------------------------------------------------|
| Question 1 | Item 1                        | What is an earthquake for you?                                        |
|            | Item 2                        | Explain, using a drawing how an earthquake was occurred?              |
| Question 2 | Explain why the earth shacks? |                                                                       |
| Question 3 | Item1                         | Will it have earthquakes in Morocco?                                  |
|            | Item2                         | Give examples of cities that have experienced earthquakes in Morocco? |
|            | Item3                         | Do earthquakes occur in Morocco?                                      |
| Question 4 | Item1                         | What to do when the earthquake struck in the classroom and at home?   |
|            | Item2                         | What to do after the earthquake?                                      |

Table 3. Student Responses to the question about earthquake definition by drawing.

| Earthquake definition using drawing | Citations numbers | Pourcentages of students (%) |
|-------------------------------------|-------------------|------------------------------|
| Unanswered                          | 40                | 21                           |
| Destroyed houses                    | 68                | 36                           |
| Homes with breaks                   | 20                | 11                           |
| Mountains with breaks               | 35                | 19                           |
| Sea waves                           | 25                | 13                           |
| Total                               | 188               | 100                          |

Table 4. Student responses to the question about the earthquake causes by writing

| Earthquake causes by writing | Citations numbers | Percentage of students (%) |
|------------------------------|-------------------|----------------------------|
| Unanswered                   | 30                | 16                         |
| Digging Mines                | 40                | 21                         |
| A very strong wind           | 30                | 16                         |
| Is a volcano                 | 20                | 11                         |
| Thunder                      | 15                | 8                          |
| Flooding                     | 28                | 15                         |
| Fracture of earth's crust    | 25                | 13                         |
| Total                        | 188               | 100                        |

Table 5. Students responses to the question relating to the earthquakes production in Morocco

| Why do earthquakes occur in Morocco? | Citations Numbers | Pourcentage of students (%) |
|--------------------------------------|-------------------|-----------------------------|
| Unanswered                           | 115               | 61                          |
| Situation between two seas           | 15                | 8                           |
| Mountain Presence                    | 20                | 11                          |
| Floods                               | 30                | 16                          |
| Population explosion                 | 8                 | 4                           |
| Total                                | 188               | 100                         |

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